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Vaginal Cuff Dehiscence: Risk Factors and Associated Morbidities

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ABSTRACT

Background and Objectives: To evaluate whether the route and surgical technique by which hysterectomy is performed influence the incidence of vaginal cuff dehiscence.

Methods: We performed a retrospective analysis of total hysterectomy cases performed at Brigham and Woman's Hospital or Faulkner Hospital during 2009 through 2011.

Results: During the study period, 2382 total hysterectomies were performed; 23 of these (0.96%) were diagnosed with cuff dehiscence, and 4 women had recurrent dehiscence. Both laparoscopic (odds ratio, 23.4; $P = .007$) and robotic (odds ratio, 73; $P = .0006$) hysterectomies were associated with increased odds of cuff dehiscence in a multivariate regression analysis. The type of energy used during colpotomy, mode of closure (hand sewn, laparoscopic suturing, or suturing assisted by a device), and suture material did not differ significantly between groups; however, continuous suturing of the cuff was a protective factor (odds ratio, 0.24; $P = .03$). Women with dehiscence had more extensive procedures, as well as an increased incidence of additional major postoperative complications (17.4% vs 3%, $P = .004$).

Conclusion: The rate of cuff dehiscence in our cohort correlates with the current literature. This study suggests that the risk of dehiscence is influenced mainly by the scope and complexity of the surgical procedure. It seems that different colpotomy techniques do not influence the rate of cuff dehiscence; however, continuous suturing of the cuff may be superior to interrupted suturing.

Key Words: Total hysterectomy, Vaginal cuff dehiscence, Laparoscopy, Robotic surgery.

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INTRODUCTION

Vaginal cuff dehiscence is an uncommon but potentially morbid complication after hysterectomy. It is defined as separation of a vaginal cuff that was previously closed. After dehiscence, there is a direct connection between the peritoneal cavity and the vagina; abdominal or pelvic contents may be expelled through the vagina, causing a wide range of signs and symptoms from minimal vaginal discharge to profuse bleeding and gastrointestinal evisceration. The incidence of this condition as reported in the literature is 0% to 7% and appears to be higher after laparoscopic and robotic approaches compared with vaginal and abdominal approaches.[1–5] Uccella et al[1] previously reported the incidence to be 0.13% when the procedure is performed by the vaginal approach, 0.2% when performed abdominally, and 0.64% when performed by the laparoscopic approach. Risk factors are ill-defined[5] and include factors that influence wound healing, as well as mechanical factors such as early resumption of sexual activity, trauma, and increased intra-abdominal pressure.[5–9]

Limited data exist about the effect of different approaches to colpotomy creation, suture materials,[2] or suturing techniques[10,11] on the risk of vaginal cuff separation.[12] Furthermore, the available retrospective reports often lack clear descriptions of the technique of colpotomy used, especially in abdominal and vaginal hysterectomies.[3] In a literature review by Uccella et al,[12] the pooled incidence of vaginal dehiscence was lower for transvaginal cuff closure (0.18%) than for both laparoscopic and robotic closure (0.64% and 1.64%, respectively). Proposed factors unique to minimally invasive procedures that could play a role in this observed difference are a magnified view that could induce the surgeon to include an insufficient amount of tissue in closure and insufficient tension maintained on the suture by traditional laparoscopic or robotic instruments rather than by the surgeon's hands.[12]

The aim of this study is to assess whether various sources of energy, suture materials, and surgical techniques applied during hysterectomy via different routes influence the incidence of vaginal cuff dehiscence.

METHODS

Institutional review board approval was obtained. We identified all women who underwent total hysterectomy at Brigham and Woman's Hospital or Faulkner Hospital during 2009 through 2011 through the Partners Research Patient Data Registry. The charts of all of the identified women were reviewed. Exclusion criteria were subtotal hysterectomies, cesarean hysterectomies, and pelvic exenterations.

Data extracted included demographic characteristics (age, race, gravity, and parity), comorbidities (smoking, diabetes, chronic steroid use or use of immunosuppressants, malignancy, connective tissue disease, vascular disease, and surgical history), indication for hysterectomy (oncologic vs non-oncologic), mode of hysterectomy, subtype of hysterectomy (simple vs radical or with extensive gastrointestinal involvement), intraoperative characteristics (mode of colpotomy and of closure, type of suture used, whether additional electrosurgical energy was used to achieve hemostasis, estimated blood loss, major intraoperative complications, and length of stay), and both major postoperative complications (requiring observation as inpatients, with or without additional treatment) and minor postoperative complications (treated on an outpatient basis, including bleeding complications, infections, organ injuries, venous thromboembolism, and cardiovascular complications). In all cases of laparoscopic hysterectomy, as well as robotic-assisted laparoscopic hysterectomy, the cuff was closed by the laparoscopic approach. Laparoscopic-assisted vaginal hysterectomies were included in the vaginal cohort. Vaginal cuff dehiscence was defined as an opening of a previously closed vaginal cuff including an opening in the peritoneum. The diagnosis was established either during routine follow-up or on examination after complaints of vaginal bleeding, discharge, or pain. In cases of vaginal cuff dehiscence, the inciting event, time to presentation, and type of treatment were recorded. Treatment of dehiscence was performed according to the surgeon's preference by the vaginal or laparoscopic route. In the case of devitalized tissue at the margins, the tissue edges were freshened. Furthermore, all cases of vaginal cuff dehiscence were examined during an in-depth chart review in an effort to identify characteristics that may have been associated with the dehiscence.

Data were summarized by use of descriptive statistics. Continuous variables were grouped into clinically meaningful categories, and the proportions of all variables in cases and controls were compared by Fisher exact tests. Logistic regression was used to adjust associations for potential confounders, and missing value indicators were used to ensure that subjects were not excluded from multivariate models.

Given the small size of the case group, attention was given to building a parsimonious model that would still adjust for potential confounders. We began the multivariate analysis by adjusting all surgical variables by 3 baseline characteristics: age, body mass index, and comorbidities. None appeared to be important confounders, so we built our multivariate model adjusting only for age. We collapsed subcategories for 2 variables to minimize the number of indicators in the model and to avoid categories without any cases: laparoscopic suturing was collapsed into 1 category (both intracorporeal and extracorporeal), and type of suture was collapsed into 2 categories (braided vs barbed). A bipolar energy source for colpotomy was used for only 1% of the total sample (28 controls and 0 cases). Because this category could not be meaningfully collapsed with the other colpotomy types, these 28 patients were excluded from the model. Intraoperative complications did not affect the results of the model once postoperative complications were included, so they were left out of the multivariate analysis. Finally, a post hoc power analysis was performed and is presented in the "Results" section.

RESULTS

During the 3-year study period, 2382 total hysterectomies were performed; 23 (0.96%) were associated with cuff dehiscence. Thirty-five percent were performed abdominally, 13% were performed vaginally, 44% were performed laparoscopically, and 8% were performed robotically. There were 4 cases of recurrent dehiscence. The baseline characteristics of dehiscence cases and controls are presented in **Table 1**. Women with dehiscence did not differ from the general cohort in terms of indications for surgery, comorbidities, or surgical history.

Table 2 presents a univariate analysis comparing operative characteristics and outcomes between cases with and without associated dehiscence. Both laparoscopic and robotic-assisted laparoscopic hysterectomies were more common in the dehiscence group. There were more major postoperative complications among women with dehiscence. Women with dehiscence did not differ from the general cohort in terms of surgical technique.

The multivariate regression analysis is presented in **Table 3**. This analysis found that women who had vaginal cuff dehiscence were younger than those who did not have

Table 1.
Baseline Characteristics of Total Hysterectomy Population, With and Without Associated Dehiscence

	No Dehiscence (n = 2359)	Dehiscence (n = 23)	Fisher Exact Test (*P* Value)
Age			
<50 y	842 (35.7%)	15 (65.2%)	.007
≥50 y	1517 (64.3%)	8 (34.8%)	
Race			
White	1739 (81.3%)	16 (80.0%)	.74
Black	189 (8.8%)	3 (15.0%)	
Asian	66 (3.1%)	0 (0%)	
Hispanic	123 (5.8%)	1 (5.0%)	
Other	16 (0.7%)	0 (0%)	
American Indian	5 (0.2%)	0 (0%)	
Missing	221	3	
BMI[a]			
<20	95 (4.7%)	3 (15.0%)	.19
20–24.9	544 (26.8%)	7 (35.0%)	
25–29.9	584 (28.8%)	5 (25.0%)	
≥30	806 (39.7%)	5 (25.0%)	
Missing	330	3	
Gravidity			
0	388 (18.7%)	6 (28.6%)	.20
1	231 (11.1%)	4 (19.0%)	
2	538 (25.9%)	2 (9.5%)	
3	382 (18.4%)	5 (23.8%)	
>3	539 (25.9%)	4 (19.0%)	
Missing	281	2	
Any comorbidity			
No	1111 (48.9%)	14 (63.6%)	.20
Yes	1159 (51.1%)	8 (36.4%)	
Missing	89	1	
Prior laparoscopy			
No	1642 (72.0%)	18 (85.7%)	.22
Yes	639 (28.0%)	3 (14.3%)	
Missing	78	2	
Prior laparotomy			
No	1441 (63.1%)	11 (52.4%)	.37
Yes	842 (36.9%)	10 (47.6%)	
Missing	76	2	
Oncologic indication for surgery			
No	1495 (63.4%)	16 (69.6%)	.67
Yes	864 (36.6%)	7 (30.4%)	

[a]BMI = body mass index.

Table 2.
Perioperative Characteristics of Total Hysterectomy Population, With and Without Dehiscence

	No Dehiscence (n = 2359)	Dehiscence (n = 23)	Fisher Exact Test (*P* Value)
Hysterectomy type			
Abdominal	832 (35.3%)	5 (21.7%)	.02
Vaginal	309 (13.1%)	1 (4.3%)	
Laparoscopic	1034 (43.8%)	11 (47.8%)	
Robotic	184 (7.8%)	6 (26.1%)	
Subtype			
Total	2183 (92.5%)	19 (82.6%)	.09
Radical/GI[a] or other major organ involvement	176 (7.5%)	4 (17.4%)	
Conversion to abdominal			
No	2296 (97.3%)	22 (95.7%)	.47
Yes	63 (2.7%)	1 (4.3%)	
Colpotomy			
Cold	1006 (44.5%)	7 (31.8%)	.56
Advanced bipolar device	28 (1.2%)	0 (0%)	
Monopolar	859 (38.0%)	11 (50.0%)	
Harmonic scalpel[b]	367 (16.2%)	4 (18.2%)	
Missing	99	1	
Mode of closure			
Hand sewn	1192 (50.7%)	8 (34.8%)	.29
Laparoscopic suturing with intracorporeal knotting	777 (33.0%)	10 (43.5%)	
Laparoscopic suturing with extracorporeal knotting	1 (0.0%)	0 (0%)	
Suturing assisted by device	382 (16.2%)	5 (21.7%)	
Missing	7	0	
Closure type			
Interrupted	891 (38.1%)	10 (43.5%)	.67
Continuous	1445 (61.9%)	13 (56.5%)	
Missing	23	0	
Suture type			
Multifilament absorbable	1807 (78.3%)	16 (72.7%)	.58
Monofilament absorbable	30 (1.3%)	0 (0%)	
Barbed	471 (20.4%)	6 (27.3%)	
Other (permanent suture)	1 (0.0%)	0 (0%)	
Missing	50	1	
EBL[a]			
≤300 mL	1923 (84.0%)	21 (91.3%)	.56
>300 mL	365 (16.0%)	2 (8.7%)	
Missing	71	0	

Table 2 continued on next page.

Table 2. (continued)
Perioperative Characteristics of Total Hysterectomy Population, With and Without Dehiscence

	No Dehiscence (n = 2359)	Dehiscence (n = 23)	Fisher Exact Test (*P* Value)
Any major intraoperative complication			
No	2262 (95.9%)	21 (91.3%)	.25
Yes	97 (4.1%)	2 (8.7%)	
Length of stay			
1 d	52 (2.3%)	2 (9.1%)	.09
>1 d	2203 (97.7%)	20 (90.9%)	
Missing	104	1	
Major postoperative complication			
None	2043 (97.0%)	19 (82.6%)	.004
Hematoma/hemoperitoneum	22 (1.0%)	2 (8.7%)	
Wound infection	16 (0.8%)	1 (4.3%)	
Ureteral/bladder injury	8 (0.4%)	1 (4.3%)	
Other	18 (0.9%)	0 (0%)	
Missing	252	0	
Any minor postoperative complication			
No	1742 (82.2%)	17 (73.9%)	.28
Yes	378 (17.8%)	6 (26.1%)	
Missing	239	0	

[a]EBL = estimated blood loss; GI = gastrointestinal.
[b]Ethicon Endo-surgery, Cincinnati, Ohio.

dehiscence. The odds ratios for dehiscence after laparoscopic and robotic hysterectomies were 23.4 ($P = .007$) and 73 ($P = .0006$), respectively. Continuous closure of the cuff was found to be protective (odds ratio, 0.24; $P = .03$). Finally, major postoperative complications multiplied the odds for dehiscence by a factor of 10 ($P = .0002$). There was a tendency toward more complicated procedures (radical hysterectomy or major organ involvement) among the women with dehiscence. Energy use during colpotomy, mode of closure (hand sewn, laparoscopic suturing, or suturing with an assisting device), and suture material did not differ significantly between groups.

The dehiscence cases are further described in detail in **Table 4**, including descriptions of recurrences where applicable. Five cases of dehiscence were treated conservatively; the rest required surgical intervention.

With an α of .05 and power of 80% and with the exposure prevalences we observed and the number of controls we have in this study, to be able to detect the odds ratios we observed for colpotomy, mode of closure, and suture type, we would need approximately 300 cases, 155 cases, and 345 cases, respectively.

DISCUSSION

The rate of cuff dehiscence in our study population, 0.96%, is compatible with the literature.[4,5,10] Both laparoscopic and, in particular, robotic-assisted laparoscopic hysterectomies were associated with higher odds of dehiscence. These findings correlate with the available literature[1,12,13] and may reflect the accumulation of more experience with laparoscopic hysterectomy than with robotic-assisted hysterectomy at our institution. As previously reported, an improvement in the experience of surgeons can help in reducing the incidence of cuff separation.[1,4,12]

We found that women with dehiscence were younger than the general cohort. All other baseline characteristics were similar between groups, including the indication for hysterectomy. The latter is in contrast to a previous study

Table 3.
Logistic Regression Analysis of Factors Associated With Dehiscence

	Crude		Multivariate Model[a]	
	OR[b] (95% CI[b])	*P* Value	OR (95% CI)	*P* Value
Age ≥50 y	0.30 (0.12–0.70)	.006	0.28 (0.11–0.70)	.007
Hysterectomy type				
Abdominal	1.00 (reference)		1.00 (reference)	
Vaginal	0.54 (0.06–4.65)	.58	1.21 (0.13–11.4)	.87
Laparoscopic	1.78 (0.62–5.15)	.29	23.4 (2.39–229)	.007
Robotic	5.84 (1.76–19.3)	.004	73.0 (6.24–854)	.0006
Subtype				
Total	1.00 (reference)		1.00 (reference)	
Radical/GI[b] or other major organ involvement	2.62 (0.88–7.78)	.08	3.58 (0.96–13.3)	.06
Colpotomy				
Cold	1.00 (reference)		1.00 (reference)	
Monopolar	1.84 (0.71–4.77)	.21	0.23 (0.02–3.54)	.29
Harmonic scalpel[c]	1.56 (0.46–5.37)	.48	0.18 (0.01–3.91)	.27
Mode of closure				
Hand sewn	1.00 (reference)		1.00 (reference)	
Laparoscopic suturing	1.95 (0.77–4.97)	.16	0.82 (0.07–9.29)	.87
Suturing assisted by device	1.95 (0.64–6.01)	.24	1.88 (0.18–19.4)	.6
Suture type				
Braided monofilament or multifilament	1.00 (reference)		1.00 (reference)	
Barbed	1.46 (0.57–3.75)	.43	1.73 (0.38–7.84)	.48
Continuous closure	0.81 (0.35–1.85)	.61	0.24 (0.07–0.86)	.03
Any postoperative complication	7.55 (2.50–22.8)	.0003	10.0 (2.97–33.9)	.0002

[a]All variables in the table were included in the multivariate model.
[b]CI = confidence interval; GI = gastrointestinal; OR = odds ratio.
[c]Ethicon Endo-surgery, Cincinnati, Ohio.

that found that when the indication was a malignancy, the risk of dehiscence increased 3-fold.[12] There is inconsistency in the literature regarding baseline characteristics associated with cuff dehiscence; some studies showed younger age to be a risk factor,[2] some cited older age as a risk factor,[14] and some did not find any significant association between age and dehiscence.[5,13] Other baseline characteristics have been sporadically studied. Hur et al[2] found a lower body mass index among women with dehiscence. Nick et al[13] reported no difference in tobacco use or diabetes between women with cuff dehiscence and those without cuff dehiscence, whereas Ramirez and Klemer[6] found that comorbidities associated with poor wound healing increased the risk of cuff dehiscence.

Surgical factors did not influence the risk of cuff dehiscence in this cohort. The surgical factors that were reviewed were type of energy used for colpotomy, mode of suture, type of suture, and suturing technique, reflecting a more comprehensive analysis of surgical factors than previous studies. Even though laparoscopic and robotic-assisted laparoscopic procedures were associated with a higher risk of dehiscence, the method of closure was not; this may be attributed to the fact that the procedures performed by a minimally invasive approach incorporate several differences from the vaginal or abdominal approaches in addition to the mode of closure (i.e., energy used for colpotomy and suture types). Because of the delayed presentation of cuff dehiscence after minimally invasive techniques, it was previously suggested that

Table 4.
Detailed Data for Cases of Dehiscence

Patient	Age (y)	Oncologic Indication	Route of Hysterectomy	Radical Hysterectomy	Time to Event (d)	Symptoms	Precipitating Event	Surgical Repair Performed	Comments
1	61		LAVH[a]		30	Bleeding		Yes	
2	46	Yes	TAH[a]	Yes	62	Acute pain, prolapse of small bowel	Coitus	Yes	Receiving chemotherapy
			Recurrent dehiscence		390[b]	Vaginal pain and mass	Valsalva	Yes	Receiving bevacizumab maintenance
3	56		TLH[a]		22	Bleeding	Coitus		
4	57		TAH		52	Vaginal drainage and pain		Yes	
5	44		TLH		17	Bleeding		Yes	
6	47		TLH		25	Bleeding and discharge		Yes	
7	40		TLH		240	Vaginal pain and mass	Valsalva	Yes	
8	48		TLH		38	Abdominal pain	Coitus	Yes	Revision of vaginal cuff scar due to dyspareunia between cases of dehiscence
			Recurrent dehiscence		90[b]	Vaginal mass	Coitus	Yes	
9	36	Yes	RaLH[a]	Yes	17	Vaginal drainage		Yes	
			Recurrent dehiscence		26[b]	Vaginal drainage		Yes	Ureteral injury diagnosed 1 d after first repair
10	52	Yes	Robotic assisted		16	Vaginal drainage		Yes	
11	47		RaLH		45	Abdominal pain	Coitus	Yes	
12	42		RaLH		31	Vaginal drainage			
13	37		TAH		99	Abdominal pain	Coitus	Yes	
14	41	Yes	TAH	Yes	70	Abdominal pain	Coitus	Yes	
15	30	Yes	TAH	Yes	87	Abdominal pain and vaginal drainage	Coitus	Yes	
16	61	Yes	TLH		30	Vaginal leakage		Yes	
17	49		TLH		75	Bleeding			
18	53		TLH		105	Pressure	Coitus	Yes	
19	30	Yes	RaLH	Yes	27	Vaginal leakage	Valsalva	Yes	

Table 4 continued on next page.

Table 4. (continued)
Detailed Data for Cases of Dehiscence

Patient	Age (y)	Oncologic Indication	Route of Hysterectomy	Radical Hysterectomy	Time to Event (d)	Symptoms	Precipitating Event	Surgical Repair Performed	Comments
20	45		TAH		45	Bleeding		Yes	Prolapsed tubes through cuff
			Recurrent dehiscence		32[b]	Bleeding		Yes	Prolapsed tubes through cuff
21	64		VH[a]		7	Bleeding			
22	45	Yes	TLH		20	Bleeding		Yes	Reoperation on POD[a] 1 due to hemoperitoneum
23	34		TLH		21	Bleeding	Coitus		

[a]POD = postoperative day; RaLH = robotic-assisted laparoscopic hysterectomy; TAH = total abdominal hysterectomy; TLH = total laparoscopic hysterectomy; VH = vaginal hysterectomy.
[b]Time from previous dehiscence.

the use of electrocoagulation on the vaginal cuff may play a significant role in impaired healing.[8] Uccella et al[1] suggested that the role of monopolar energy is minimal in the pathogenesis of cuff dehiscence. Other authors concluded that the application of excessive bipolar electrosurgery (>40 W and ≥4 seconds) tends to weaken suture material.[15] Previous studies have not compared the use of ultrasonic energy as a means of colpotomy with other more commonly used techniques. In this study we had the advantage of including a wide variety of colpotomy methods. Nevertheless, neither different energy sources nor the use of additional energy to achieve hemostasis influenced the risk of dehiscence in our findings. However, given the small sample size of vaginal cuff dehiscence patients, the lack of significance could be a type II error.

According to several previous small cohorts, the use of bidirectional barbed suture seems promising as means to reduce the risk of dehiscence.[5,11] Hur et al[4] previously speculated that switching from cuff closure with Polysorb suture (Covidien, Dublin, Ireland) to delayed absorbable monofilament suture may have resulted in a decreased incidence of cuff dehiscence. Other authors suggested that using a 2-layer closure may help reduce the risk even further.[5] In our study, continuous suturing of the cuff was associated with a decreased risk of cuff dehiscence; however, neither type of suture nor mode of suture affected the risk of cuff dehiscence.

Although women with dehiscence did not differ from the general cohort in terms of indications for surgery (i.e., oncologic vs non-oncologic indications), there was an increased incidence of major postoperative complications, as well as a tendency toward a more extensive initial surgical procedure (i.e., radical hysterectomy or other major organ involvement outside of the urogenital tract), among cases of dehiscence. This finding may be attributed to an interruption with normal wound healing and increased intra-abdominal pressure, as previously suggested in the literature.[3] Ceccaroni et al[3] did not find increased major postoperative complications among women with cuff dehiscence, whereas Ramirez and Klemer[6] concluded that postoperative vaginal cuff infection or hematoma may be a risk factor for vaginal cuff dehiscence. Our findings implicate that the risk of cuff dehiscence may be influenced by the scope of the surgical procedure and its complexity rather than by different techniques used for colpotomy and colporrhaphy.

There were 4 cases of recurrent dehiscence among our cases (17% of dehiscence cases). Recurrent dehiscence has only been previously described in one article, in

which all cases occurred after robotic procedures. In their review, Kho et al[8] encountered 3 patients with recurrent dehiscence, which comprised 14% of those who underwent surgical repair for dehiscence. They concluded that the risk of recurrence stems from insufficient mobilization and trimming of the edges during dehiscence repair. In our series, 2 cases of recurrence occurred after abdominal hysterectomy, 1 case followed traditional laparoscopy, and the fourth case occurred after robotic surgery. Hysterectomy was performed because of malignancies in 2 women and because of fibroids in 2 women. The time to recurrent dehiscence ranged between 26 and 390 days. It is difficult to draw significant conclusions regarding recurrent cuff dehiscence because of the rarity of this complication. However, it is prudent to keep in mind that this can occur even after a significant lag time and to monitor and educate patients accordingly.

The main strength of this study is that all women in this cohort received treatment at the same institution over a limited period, as well as during recent years, which serves as a good indicator of relevant surgical proficiencies incorporating current technology. We have also attempted to include in our analysis a comprehensive list of patient and surgical factors that may affect the risk of dehiscence. This cohort suffers the limitations of a retrospective analysis. Furthermore, the possibility of a type II error in our study is a real consideration given the relative rarity of vaginal cuff dehiscence. As stated in the "Results" section, to achieve statistical significance in the difference among different modes of colpotomy, modes of closure, and suture types, our case cohort would have to be 10 times larger.

CONCLUSION

Our data confirm the previously suggested increased risk of cuff dehiscence after laparoscopic and robotic hysterectomies compared with alternate approaches. Furthermore, we found that dehiscence appears to be predominantly mediated by the scope of the initial surgery and is frequently accompanied by other major postoperative complications, specifically hemoperitoneum. Continuous suturing of the cuff may be superior to interrupted suturing. Finally, our experience shows that dehiscence may recur and should be monitored accordingly.

References:

1. Uccella S, Ceccaroni M, Cromi A, et al. Vaginal cuff dehiscence in a series of 12,398 hysterectomies: effect of different types of colpotomy and vaginal closure. *Obstet Gynecol.* 2012;120(3):516–523.

2. Hur HC, Guido RS, Mansuria SM, Hacker MR, Sanfilippo JS, Lee TT. Incidence and patient characteristics of vaginal cuff dehiscence after different modes of hysterectomies. *J Minim Invasive Gynecol.* 2007;14:311–317.

3. Ceccaroni M, Berretta R, Malzoni M, et al. Vaginal cuff dehiscence after hysterectomy: a multicenter retrospective study. *Eur J Obstet Gynecol Reprod Biol.* 2011;158:308–313.

4. Hur HC, Donnellan N, Mansuria S, Barber RE, Guido R, Lee T. Vaginal cuff dehiscence after different modes of hysterectomy. *Obstet Gynecol.* 2011;118:794–801.

5. Cronin B, Sung VW, Matteson KA. Vaginal cuff dehiscence: risk factors and management. *Am J Obstet Gynecol.* 2012;206(4):284–288.

6. Ramirez PT, Klemer DP. Vaginal evisceration after hysterectomy: a literature review. *Obstet Gynecol Surv.* 2002;57:462–467.

7. Robinson BL, Liao JB, Adams SF, Randall TC. Vaginal cuff dehiscence after robotic total laparoscopic hysterectomy. *Obstet Gynecol.* 2009;114(2 Pt 1):369–371.

8. Kho RM, Akl MN, Cornella JL, Magtibay PM, Wechter ME, Magrina JF. Incidence and characteristics of patients with vaginal cuff dehiscence after robotic procedures *Obstet Gynecol.* 2009; 114(2 Pt 1):231–235.

9. Drudi L, Prez JZ, Lau S, et al. Vaginal vault dehiscence after robotic hysterectomy for gynecologic cancers: search for risk factors and literature review. *Int J Gynecol Cancer.* 2013;23(5): 943–950.

10. Blikkendaal MD, Twijnstra AR, Pacquee SC, et al. Vaginal cuff dehiscence in laparoscopic hysterectomy: influence of various suturing methods of the vaginal vault. *Gynecol Surg.* 2012; 9(4):393–400.

11. Siedhoff MT, Yunker AC, Steege JF. Decreased incidence of vaginal cuff dehiscence after laparoscopic closure with bidirectional barbed suture. *J Minim Invasive Gynecol.* 2011;18(2):218–223.

12. Uccella S, Ghezzi F, Mariani A, et al. Vaginal cuff closure after minimally invasive hysterectomy: our experience and systematic review of the literature. *Am J Obstet Gynecol.* 2011;205: 119.e1–119.e12.

13. Nick AM, Lange J, Frumovitz M, et al. Rate of vaginal cuff separation following laparoscopic or robotic hysterectomy. *Gynecol Oncol.* 2011;120:47–51.

14. Croak AJ, Gebhart JB, Klingele CJ, Schroeder G, Lee RA, Podratz KC. Characteristics of patients with vaginal rupture and evisceration. *Obstet Gynecol.* 2004;103:572–576.

15. Sol ES, Hong SY, Oh HK, Kim AS, Sin JI, Choi YS. Can bipolar electrosurgery be performed over suture sites without compromising tensile strength of suture material during laparoscopic myomectomy? *J Minim Invasive Gynecol.* 2011;18(2):157–163.